

REMARKS

Claims 1-8 remain pending after this amendment.

Claim Amendments

By this amendment, an inadvertent typographical error in claim 1 is corrected. No new matter is added by this amendment.

Objection to Claim 5

The Examiner objects to claim 5 as allegedly being redundant. Applicants inform the Examiner that claim 5 is not redundant, as claims 5, 7, and 8 each depend from different claims.

Rejection under 35 USC 112 (paragraph two)

Claims 1-8 stand rejected under 35 USC 112 (paragraph two) as not distinctly claiming the invention. This rejection respectfully is traversed to the extent deemed to apply to the claims as amended.

In response, claim 1 is amended to correct an inadvertent typographical error which apparently caused confusion on behalf of the Examiner, for which applicants apologize.

In view of this amendment, the rejection is believed to be moot and should be withdrawn.

Applicants' Invention

The present invention relates to a thermoplastic resin composition comprised of:

[A] 100 parts by weight of a polyacetal resin or thermoplastic aromatic polyester resin,

[B] 0.1 to 20 parts by weight of a graft polymer in which (B-2) a vinyl (co)polymer component comprising at least one vinyl compound is graft-polymerized on (B-1) an olefin polymer as a backbone polymer, and

[C] 0.1 to 10 parts by weight of a liquid ethylene/ α -olefin random copolymer comprising ethylene and an α -olefin having 3 to 20 carbon atoms, which random copolymer has:

(i) a proportion of a structural unit derived from ethylene of from 20 to 80 mol% and a proportion of a structural unit derived from α -olefin of from 20 to 80 mol% based on all structural units,

(ii) a number average molecular weight (M_n) of from 500 to 10000,

(iii) a molecular weight distribution (M_w/M_n) determined by a ratio of a weight average molecular weight (M_w) to a number average molecular weight (M_n) of from 1.2 to 3, and

(iv) a pour point of lower than 20 °C.

In the resin composition, the thermoplastic resin [A] and the liquid ethylene/ α -olefin random copolymer [C] disperse

uniformly without phase separation. Thereby such resin compositions have excellent molding processability. That is, there is neither deterioration in appearance such as surface wetting and peeling of molded articles, nor mold contamination when formed into molded articles, because of improved mold-releasability during molding.

The resin compositions can be used to prepare molded articles having excellent sliding properties, wear resistant properties and impact resistance without impairing the mechanical properties of resin articles.

Furthermore, blending the graft copolymer [B] with the thermoplastic resin [A] in the above amounts, permits the liquid ethylene/ α -olefin random copolymer [C] to be dispersed homogeneously in the resin [A] without occurrence of phase separation, enabling a resin composition having the excellent properties to be prepared. When the resin composition is molded into molded articles, the molded article surface has no wetting nor inferior appearance such as peeling. In molding, the resin composition has no mold contamination because the mold releasability thereof is improved, and has excellent mold processability and, further, the impact strength is lowered.

Applicants' invention is neither disclosed nor suggested by the cited prior art.

Rejection of Claims 1 and 5 under 35 USC 103(a)

Claims 1 and 5 stand rejected under 35 USC 103(a) as being unpatentable over Niino et al in view of Hirano et al. This rejection respectfully is traversed.

Niino discloses a polyoxymethylene resin composition comprising (A) a polyoxymethylene resin and (B) a polyolefin resin having a molecular weight distribution Mw/Mn of not more than 3 and containing 60 to 100 % by weight of an ethylene unit based on the whole polyolefin resin.

Niino teaches that (B) a polyolefin resin may be subjected to graft-modification with a vinyl monomer other than ethylene.

Furthermore, Niino teaches that a lubricating agent may be added to the resin composition, which can reduce the reciprocal friction coefficient of the polyoxymethylene resin composition. As the lubricating agent, liquid ethylene α -olefin random copolymer is mentioned.

As described above, the graft-modification polyolefin resin and the liquid ethylene α -olefin random copolymer are described in Niino. However, these components are optional components added to composition. Therefore, the combined use of the graft-modification polyolefin resin and the liquid ethylene α -olefin random copolymer are neither disclosed nor suggested in Niino.

By blending the graft copolymer [B] with the thermoplastic resin [A] in the above amounts, liquid ethylene/ α -olefin random

copolymer [C] can be dispersed homogeneously in the resin [A] without occurrence of phase separation. As a result, a resin composition having low mold contamination, excellent moldability, excellent frictional wear properties, and favorable impact may be prepared.

By contrast, unless the liquid ethylene/ α -olefin random copolymer [C] and the graft copolymer [B] are used in combination, it is difficult to improve the sliding properties, wear resistant properties and impact resistance of articles. That is, the objects of the present invention cannot be accomplished.

The advantages of the present invention are clearly described in the present specification as shown in Example 1, and Co-Examples 2 and 3. In Co-Example 2, the mixing procedure of Example 1 was repeated except that the liquid ethylene/ α -olefin random copolymer was not used. In Co-Example 3, the mixing procedure of Example 1 was repeated except that the ABS resin was not used.

The results are shown in Table 1 below:

Table 1

	Ex. 1	Co-Ex.2	Co-Ex.3
[A] Polyacetal resin	100	100	100
[B] Graft copolymer	5	5	
[C] Ethylene/ α -olefin copolymer:EP1	3		3
Mold contamination	AA	AA	CC
Molded article appearance	AA	AA	CC
Dispersed particle diameter (μm)	0.4-1.0	-*1	0.3-4.0
Coefficient of Dynamic friction	0.1597	0.3237	*2 Measurement was unfeasible.
Abrasion loss (mg)	27.4	72.7	
Izod impact strength (J/m)	115	110	79

*1: The component [C] was not added, so that there were no data.

*2: The surface of the molded article had much roughness so that measurement could not be conducted.

In Co-Example 2, the coefficient of dynamic friction is too high, and abrasion loss is too great.

In Co-Example 3, since the component is poorly dispersed, the coefficient of dynamic friction is too high, and abrasion loss is too great.

Niino thus does not disclose or suggest the claimed invention. The deficiencies of Niino are not overcome by the citation of Hirano.

Hirano discloses that a molding resin composition comprising:

(A) 100 parts by weight of a resin selected from the group consisting of polyacetal resin, ABS resin, polyamide resin,

polyphenylene oxide resin, polyimide resin, thermoplastic polyester resin, polycarbonate resin, epoxy resin, thermosetting unsaturated polyester resin and phenolic resin, and

(B) 0.1-15 parts by weight of, at room temperature, a liquid ethylene- α -olefin random copolymer having polar groups,

wherein (a) said ethylene- α -olefin random copolymer comprises 30-70 mole % of ethylene unit and 30-70 mole % of α -olefin units based on its total structural units, and wherein said ethylene- α -olefin random copolymer having polar groups has (b) a number average molecular weight (M_n) of 500-10000, and (c) a molecular weight distribution (M_w/M_n) represented by the ratio of the weight average molecular weight (M_w) to the number average molecular weight (M_n) of 1.2-3.

In Hirano, a liquid ethylene- α -olefin random copolymer having polar groups is present in the composition. By contrast, a thermoplastic polyester resin [A], graft copolymer [B] and liquid ethylene/ α -olefin random copolymer [C] are used in combination in the present invention. That is, the graft copolymer [B] is present as an essential component in the present invention. The graft copolymer is different from the liquid ethylene- α -olefin random copolymer having polar groups.

The graft copolymer [B] of the present invention is comprised of the olefin polymer (B-1) as a backbone polymer, and the vinyl (co) polymer (B-2) as a graft chain. Due to the

presence of the two different polymeric components in the graft copolymer [B] molecule, the compatibility between thermoplastic polyester resin [A] and the liquid ethylene/ α -olefin random copolymer [C] is much improved.

The polar groups in the liquid ethylene- α -olefin random copolymer having polar groups of Hirano are low molecular weight and accordingly do not improve the compatibility between thermoplastic polyester resin [A] and the liquid ethylene/ α -olefin random copolymer [C].

Due to the presence of the graft copolymer [B], the liquid ethylene/ α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A] without occurrence of phase separation. As a result, the resin compositions have excellent molding processability. That is, neither deterioration in appearance such as surface wetting and peeling of molded articles, nor mold contamination occurs when formed into molded articles due to improved mold-releasability in molding.

These effects of the graft copolymer [B] are shown in the following Table 2:

Table 2

		Ex. 6	Hirano Trace
[A] Polyacetal resin		100	100
[B] Graft copolymer		5	
[C] Ethylene / α -olefin copolymer	EP1	3	
*1) copolymer having polar groups			3
Dispersed particle diameter (μ m)		0.1-1.0	0.4 ~ 10
Coefficient of Dynamic friction		0.1442	0.2031
Abrasion loss (mg)		2.6	1.0
Izod impact strength (J/m)		76	46

*1: The Ethylene/ α -olefin copolymer is modified by maleic anhydride as described in Hirano Examples.

Since the graft copolymer [B] is present in the composition, the compatibility between thermoplastic polyester resin [A] and the liquid ethylene/ α -olefin random copolymer [C] is much improved, the dispersed particle diameter of Example 6 is smaller than that of Hirano trace. The resin compositions have excellent molding processability. That is, there is neither deterioration in appearance such as surface wetting and peeling of molded articles, nor mold contamination when formed into molded articles.

In view of the above, the rejection is without basis and should be withdrawn.

Rejection of Claims 1-8 under 35 USC 103(a)

Claims 1-8 stand rejected under 35 USC 103(a) as being unpatentable over either Kodama et al or Kato et al in view of Hirano. This rejection respectfully is traversed.

Kodama discloses a thermoplastic resin composition comprising a mixture of:

(A) a rubber-reinforced styrene resin which is obtained by graft polymerizing styrene and acrylonitrile in the presence of a rubbery polymer selected from the group consisting of polybutadiene, ethylene-propylene-diene monomer rubber and acrylate copolymers (ABS resin),

(B) polybutylene terephthalate (PBT),

(C) maleimide copolymer comprising (i) N-phenylmaleimide, (ii) styrene and (iii) acrylonitrile or of acrylonitrile and methyl methacrylate, and

(D) an epoxy group-containing olefinic copolymer.

Kodama fails to teach the presence of a liquid ethylene/ α -olefin random copolymer [C] in the disclosed composition.

The composition of Kodama further comprises a maleimide copolymer and an epoxy group-containing olefin copolymer, which are distinct from the components of the present invention.

By blending the graft copolymer [B] with the thermoplastic resin [A] in the above amounts, liquid ethylene/ α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A]

without occurrence of phase separation. A resin composition having low mold contamination, excellent moldability, excellent frictional wear properties, and favorable impact is thus produced.

The advantages of the present invention are clearly described, for example, at Examples 6 and 7 and Co-Example 7 of the present specification.

The compositions of Examples 6 and 7 contain [A] the polybutylene terephthalate, [B] ABS resin and the liquid ethylene/ α -olefin random copolymer [C]. By contrast, the composition of Co-Example 7 does not contain the liquid ethylene/ α -olefin random copolymer [C]. The resulting polybutylene terephthalate composition was molded to prepare a molded article and it was evaluated in the same manner as in Example 1. The results are shown in Table 3:

Table 3

		Ex. 6	Ex.7	Co.Ex.7
Resin composition				
[A] Polybutylene terephthalate resin		100	100	100
[B] Graft copolymer (ABS)		5	5	5
[C] Ethylene / α -olefin copolymer	EP1	3	5	
	EP2			
	EP3			
	EP4			
Evaluation result				
Mold contamination		AA	AA	AA
Molded article appearance		AA	AA	AA
Dispersed particle diameter (μ m)		0.2-1.0	0.2-2.0	-*1
Coefficient of Dynamic friction		0.1442	0.1367	0.3355
Abrasion loss (mg)		2.6	2.4	12.5
Izod impact strength (J/m)		76	68	63

*1: The component [C] was not added, so that there were no data.

In Co-Example 7, the coefficient of dynamic friction is too high, and abrasion loss is too great.

Unless the liquid ethylene/ α -olefin random copolymer [C] and the graft copolymer [B] are used in combination, it is difficult to improve the sliding properties, wear resistant properties and impact resistance of articles. That is, the objects of the present invention cannot be accomplished.

Kato discloses a polybutylene terephthalate resin composition comprising:

(A) a polybutylene terephthalate resin;

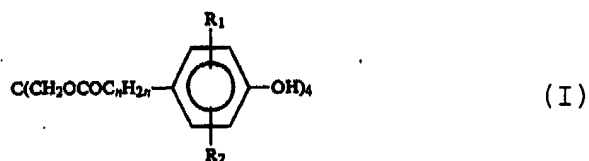
(B) a copolymer of acrylonitrile and styrene;

(C) a graft copolymer comprising:

(C1) from 65 to 75% by weight of copolymer comprising from 75 to 85% by weight of ethylene and from 25 to 15% by weight of glycidyl methacrylate, and

(C2) from 25 to 35% by weight of a copolymer of acrylonitrile and styrene;

(D) from 0.05 to 0.5 part by weight of a hindered phenol compound represented by formula (I):



wherein n represents an integer of from 0 to 6, and R₁ and R₂ each represents an alkyl group having from 1 to 6 carbon atoms, a substituted alkyl group having from 1 to 6 carbon atoms, or a cycloalkyl group having from 3 to 6 carbon atoms; and

(E) from 0.05 to 0.5 part by weight of a thioether compound represented by the following formula (II):



wherein m represents an integer of from 1 to 4, R₃ represents an alkyl group, and R₄ represents an alkylene group.

Kato relates to a connector, which is lightweight and excellent in dimensional stability, heat resistance, mechanical property, and productivity, and also in fitting feeling.

However, Kato is silent with respect to the presence of a liquid ethylene/ α -olefin random copolymer [C] as required by applicants.

The composition of Kodama is comprised of a maleimide copolymer and an epoxy group-containing olefin copolymer, and is accordingly distinguishable from applicants' invention.

In summary, by blending the graft copolymer [B] with the thermoplastic resin [A] in the above amounts, liquid ethylene/ α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A] without occurrence of phase separation. Thereby a resin composition having low mold contamination, excellent moldability, excellent frictional wear properties, and favorable impact is prepared.

These advantages are clearly demonstrated in applicants' specification, such as at Examples 6-7 and Co-Example 7.

As described above, unless the liquid ethylene/ α -olefin random copolymer [C] and the graft copolymer [B] are used in combination, it is difficult to improve the sliding properties, wear resistant properties and impact resistance of articles, that is, the purpose of the present invention cannot be accomplished.

Further, the claimed combination of liquid ethylene/ α -olefin random copolymer [C] with the graft copolymer [B] as recited in applicants' claims is neither taught nor suggested by the cited references. Nor do the cited references teach the claimed combination of components [A], [B] and [C].

In view of such deficiencies in the teachings of the references, the rejection is without basis and should be withdrawn.

The application is now believed to be in condition for allowance and an early indication of same is solicited.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a one (1) month extension of time for filing a reply in connection with the present application, and the required fee of \$110.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART KOLASCH & BIRCH, LLP


By 

Raymond C. Stewart, #21,066

P.O. Box 747

Falls Church, VA 22040-0747

(703) 205-8000


RCS/JWH/sh
1155-0245P